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Thesis

Etiology and Prophylaxis of Puerperal Infection

Tyre K. Jones

## Etiology and Prophylaxis of Puerperal Infection

Puerperal infection is a general term referring to an infectious process arising from the invasion, by infectious organisms, of wounds made in the process of an abortion or a normal labor. The infection may remain localized or be spread to any other part of the body by direct contact of body tissues, by lymph, or by blood stream infection. (1)

Puerperal infection and its synonym, puerperal sepsis, are more recent terms replacing the older one, puerperal fever. Since by definition the disease is an infection of a wound, fever is but a symptom and sepsis a complication, while neither fever nor sepsis is necessary in the establishment of a puerperal infection. (2)

The symptoms of the disease vary with the type of the disease present. With a mild infection of low virulence in an individual of good resistance, there may be a slight rise in temperature or pulse rate for a few hours. In a different situation, the disease may produce a high temperature with a septic curve shown on the chart and, with a septicemia developing, end by death within a few days. (3) When a woman has recently miscarried, aborted or delivered a full term fetus, she is said to be in a morbid state should she exhibit any of the signs of infection or fail to return to the normal condition as rapidly as obstetric practice indicates she should recover. (4) Any

of the bacteria concerned in wounds in general may be the causative factor whether they are the mildest of occasional pathogens or the most virulent of the streptococci. The pathology begins in a preexisting wound or one produced by the process of labor. It is said that there is never a labor without some trauma produced, even though the labor be entirely normal in every respect. The infectious agent enters the tissues by some break in continuity and from this point a puerperal infection is established. The infection may lodge in the traumatized area from some focal point distant from this site or be present in the vagina or cervix before delivery. It may be from contamination of the field of delivery from the neighboring rectum or urethra or be carried by an attendant during confinement or postpartum into the birth canal by inoculated hands, instruments or other means of the spread of contagion. (3)

Since the disease is primarily a wound infection, it has been present without doubt since earliest times. It is not a disease of man exclusively as the veterinarian also deals with it in his practice. In studies of primitive tribes, evidence is found of puerperal infection in tribal customs designed to limit the disease by isolation, bathing in oils, magic medicines, etcetera. In studies of modern explorers, savage tribes in Africa are found to have similar customs which serve to limit infections that tend to become epidemic in character and take lives like a plague.

The first mention of the disease goes back to a thousand

years before Christ. By Hippocrates' time, the disease was well known. In the works of Hippocrates is given an accurate description of the disease that might be read in the modern classroom. He considered that the disease was due to the suppression of the lochia and on account of this, his treatment was purgation. (5)

The credit for naming the disease is given to Thomas Willis who, in 1662, gave a description of "febris Puerperarum". Richard Morton is considered to have used the English term puerperal fever the first time in 1692, and at this time, he gave a definition of the disease that corresponds to its modern one. Before this time, it was confused with other diseases that had similar fevers and symptoms but which were not puerperal. By post mortem examinations, some of the gross pathology of various diseases was becoming better understood, but the sex of the patient made study of the living for many of the most brilliant of the early writers an impossibility, as the care of women in childbirth was considered work for midwives only.

During the seventeenth century, the findings of Hippocrates were just beginning to be questioned through original investigation and, with this change, there began to be other ideas as to the cause of childbirth fever. Writers of this period gave new possible causes for the sickness from their own observation. One thought it was due to the milk drying up and, turning inward, so affect the lochia as to make it milky. Another, a chemist, claimed that he had made butter from the lochia of a puerpera,

which tended to prove the milk metastasis theory. The air bourne source of the infection was another popular theory of that period, since it seemed to be propagated like other contagion. The pathology of the disease was discovered as a metritis, or a peritonitis, or a lymphangitis. (3)

In 1770, Leveret wondered if Smellie's forceps might not be carrying infection in the interstices of the meshes of their leather cover. Charles White, in 1772, reported that the discharges from a puerperal fever patient might infect healthy patients. He suggested that scrupulous cleanliness might prevent the spread of the disease. Some writers contend that the modern theory of puerperal fever dates from White. (8) In 1768, Denman declared that the disease was carried by physicians and midwives from one puerpera to another. Thomas Watson, in 1842, is said to have taught his students that contagion was carried by doctors on their hands and recommended that chlorin water abolutions would lessen the infection. The history is conflicting in many of the details of first discoveries, first usage, et cetera. Probably many are deserving of credit that is not accorded them; probably many receive it for putting forth ideas that they little believed themselves. In the past, distances were greater, a communication more indirect so it is of little wonder that ideas might be established independently in different countries and each seem to be original.

At least three men are considered to have discovered the

cause of puerperal fever~~and~~ to have done some work in teaching the theory to others. One is Thomas Watson in England, another is Holmes in the United States and <sup>the other</sup> Ignatz Phillip Semmelweis of Vienna. Watson has been mentioned above with the date of 1842 and Holmes is given the same date in America. Credit is usually given to Holmes and Semmelweis and preceding investigators are but mentioned. (5)

Dr. Oliver Wendell Holmes is probably better known as an author but he was also a physician. He happened to read of the death of a physician who developed a high fever and died from an apparently innocent finger wound that he received in performing autopsy. Becoming interested in the incidence, he looked through the literature and found other similar deaths after performing autopsies. By tracing disease reports, he found that puerperal fever seemed to follow certain doctors and that these doctors were also handling certain contagious cases at the same time. In his own practice, he found that there were occasional disastrous runs or series of puerperal fever. By the next year, he worked out an hypothesis that seemed to cover at least some of the causes of the disease. He read a paper before the Boston Society for Medical Improvement on "The Contagiousness of Puerperal Fever". (6) In this paper, he stated that physicians should limit their practice if they were doing postmortem examinations or caring for contagious diseases and not care for confinement cases at the same time. He advised as a prophylactic

against spreading disease, the thorough washings of the hands in a solution of calcium chloride and even changing the clothes after caring for a case of puerperal fever. He cited clinical reports of contagion carried from patient to patient and said that the new cases were not coincidences but the result of inoculation by the attending physician. This report caused considerable controversy in the society and his report was denounced by the leading physicians of the time. Two obstetricians, Dr. Hodge and Dr. Meigs, took the opposite side and, in replying articles, gave their methods and disproved the "crazy notions" that Dr. Holmes had advanced. (5) Holmes did not give up his idea even in the face of the storm of abuse that it had created for him. Instead he retired and worked out some more data for his theory and found it plentiful. In 1855, he returned to the same society with another paper entitled "Puerperal Fever as a Private Pestilence". (7) He had become somewhat bitter with the reception his work had received and he now wished to place the blame for childbed fever on the head that deserved it. (5) After this paper, he turned to other subjects. He had given his idea to the world and laid the proofs of the cause as he understood it before the group that should receive it. Other men took up the theory and gradually it became accepted.

In the second paper, Holmes had cited a man in Vienna who was using a method similar to the one he advanced. This man had immediately produced a remarkable drop in his mortality rate



in a clinic doing obstetrical work. This man is the same as the Semmelweis that we know in the history of Puerperal Fever.

Ignatz Phillip Semmelweis was an assistant in the first obstetric ward of the Allgemeines Krankenhaus in Vienna. He found that he had become connected with a ward, that through public knowledge, was a rather poor place to go for a confinement. In the second ward, where the midwives were taught, a comparatively low mortality was found. His ward was for the teaching of medical students in obstetrics. The death rate of his ward was about 10% while the mortality in the midwives ward was about 4%. He compared the two wards and found that their technique was very similar. He thought that the second ward looked cleaner than his but this was not regarded as a detail of particular moment. His students performed autopsies on the too many women who died, but the midwives did none. The autopsy room was next door to his ward and traffic came and went through the connecting doors. He found that in general, midwives had a better showing than the students with the exception of one clinic where the midwives also did autopsies. With the death of an associate and his postmortem examination, he noticed that the appearance of the internal organs was similar to those of the women dying from puerperal fever. In studying over the data at hand, he considered the coincidence in the fact that his friend's death seemed to date from a slight wound he had received at an autopsy just before his fatal illness. He had read of certain solutions which were supposed to prevent the carrying of contamination if such

a thing could be in existence. He decided that this might be a case of carried contamination and immediately set about to correct it. He ordered a basin containing a solution of calcium chloride to be set at the door connecting with the autopsy room and that everyone, on entering his ward, should wash thoroughly in this solution and even brush out the dirt under the finger nails. His mortality rate immediately took a gratifying drop down to the level of the midwives rate. By the following year, his mortality had dropped even below this figure to 1.27%. He announced in 1847, that puerperal fever was caused by the carrying of contaminated matter of animal origin on the hands and instruments and was placed directly in the birth canal by the operator at delivery. He further stated that this matter was capable of giving the disease to the new patient by spreading into her blood stream from the inoculated site. He cited his practical experiment and in comparative case studies, showed that the disease could hardly be a coincidence. In his ward, women who delivered before reaching the hospital and on whom no examinations were made rarely took the disease. Those who had hard deliveries on the contrary were likely to take the disease. Women who required instrumental delivery were almost always affected and many died. He showed that when a necrotic cervical carcinoma was present in his ward that there ensued a sickening run of puerperal fever. Likewise when a woman who had a badly infected knee entered the hospital, there was a series of 19 deaths that followed. His theory seemed to work out and hold

true. The more he looked about him, the clearer it became that this was the true explanation of the cause of the disease.(3,5,9)

He presented his findings and expected acknowledgement of its worth. Instead he was greeted as Dr. holmes had been, with distrust,unbelief and even ridicule. Since his theory was based on research and observation, he could not drop it as a mistake, yet he received no support from the profession he was trying to advance. The idea became an obsession with him, and still without support, he became disgusted with the clinic and his colleagues and quit his post. He moved from Vienna to Budapest and here became connected with the University as a professor in obstetrics. He again established his prophylactic technique against puerperal fever. Here he published a paper entitled "The Cause, Concept and Prophylaxis of Puerperal Fever". As before, he failed to win support and commendation for his work. He became more bitter and began to brood over his wrongs. He failed to realize that this was the typical reception of all new ideas, which had to tear down the theories and practice of the foregoing centuries in order that a place could be made for them in the minds of a conservative world. His colleagues here received his ideas with suspicion for they conflicted with the teachings they had received on the propagation of contagion. Semmelweis began to consider himself persecuted and wronged, and feeling that the world was against him, he became more and more embittered. His mind became affected and gradually he lost control of his faculties. He died in an asylum, without friends,

and a pauper; and curiously of pyemia, the disease he sought to prevent among the lying<sup>in</sup> women. (3)

After Semmelweis and Holmes, the theory they promulgated slowly gained credence in the medical profession. Younger men, without the prejudice to new ideas that comes with time, could better accept the new principles. Youth, with its tendency to accept a radical view instead of the time honored theories of mature judgment, began to be attracted by the new theory of infection. No great progress from this point was made however, until obstetrics, along with surgery, was improved by the antiseptics of Lister and the acceptance of the germ theory of disease advanced by Koch and Pasteur. (5)

With the establishment of Listerism, a rigid antiseptic technique was used in surgery, with the use of strong antiseptics and carbolic sprays over the operating field. In Obstetrics, the principles were modified in that strong antiseptic douches were given before, during and after delivery. Gradually antisepsis gave way to the less harmful asepsis. It became possible in surgery to secure a sterile field and the dread of air borne infection became lessened. In obstetrics, the sterile field has yet to be developed since the urethra just above and the rectum just below border on the vagina which itself is never sterile. (3)

The bacteriology in puerperal infection is the same as that of wound infections in general. Almost every discovered pathogenic bacterium has been found to have caused puerperal infection. Often a culture cannot be obtained before death with the certainty that this strain was the cause of the disease. Blood cultures are frequently sterile even with an almost certain septicemia. Bacteria in the blood stream must necessarily be in small quantity or death would be precipitate. Often cultures show the presence of a mixed infection with the causative organism diagnosed on conjecture. (11) The disease does not depend on the knowledge of the exact infecting agent for its treatment except in a few instances such as in the case of *B. Welchii*, *B. Tetani* and *B. Diphtheriae*. These are not common offenders. In the usual infection, the treatment remains the same, whether a virulent or a mild type of infection be present. The prognosis however, is affected by the type of organism that is causative since the virulence of the organism and the type of pathology it produces varies markedly.

Dr. George Geddes in England, has worked out a statistical relationship of puerperal infection and ordinary wound infection. In studying mortalities from a coal mining region, he found a distinct fall in the incidence to puerperal infection occurred during a strike affecting all the mines. At this time, the men were not so subject to accidents and wound infections. To prove his point of the direct relationship, he showed that city districts were unaffected and that upon re-

suming work, the old rate of incidence to puerperal infection was again found. (12)

Streptococci, all types, have been found to be the most common cause of virulent puerperal infections. (13) Pasteur, in 1880, was the first to cultivate streptococci from cases of puerperal fever. With Doléris, he showed that streptococci were the usual cause of infections in childbirth, but that other bacteria were also able to cause the disease. (2) In general, a streptococcic infection is more apt to produce death, but this prognosis varies with other factors in individual cases. If the patient has been harboring the organism, as is found in quite a high percent of women, the disease is less apt to be of the malignant type because the resistance to that strain is more likely to be good. A different strain, however, coming from an outside source and attacking the site of labor's trauma, may be very virulent even though its carrier was but little affected by its presence. Streptococcic infections are more virulent than the next common wound contaminations, the staphylococci, in that they have a lessened tendency to localize. (10)

Staphylococci, coming next in order of frequency, tend to remain localized and produce large quantities of pus. Aureus is more often found than Albus or Citreus types. Of these three, Aureus has the greatest tendency to spread from the local site.

The Gonococcus (Diplococcus of Neisser) is another frequent cause of puerperal infection. Its incidence is vari-

ously given as from 10% to 17% in all puerperal infections. It usually produces a mild type of infection, rarely causing death. Symptoms of gonorrheal infection usually delay their appearance for about a week after delivery. It is marked by local pus collection and purulent exudates. (2)

B. Coli, as might be suspected from the close proximity to the rectum, is a frequent etiological factor. With an infection of the organism, the cultures obtained are apt to be of the mixed type. Infection is usually local unless another type of more virulence is accompanying it. There is the exhibition of fetid lochia and low grade toxemia in evidence with this contamination. With a streptococcic infection accompanying it, the infection may have a high mortality. (11)

B. Welchii infection is not common after normal labor but is a fairly frequent cause of infection after criminal abortion. It should be suspected if the lochia is frothy or gaseous and specific treatment instituted. As a rule, it is a local disease living in decomposing animal matter as a saprophyte; but at times, it may become general and produce death in a very short time. DeLee and Williams both suggest that this disease has been mistakenly diagnosed as air emboli many times. (11)

B. Diphtheriae is not a common cause but may occur. The specific treatment shows remarkable results when this is the offender. (3) The pneumococcus is rarely found to be a cause.

B. Typhosis may infrequently cause the disease from contamination with typhoid carriers.

B. Tetani is becoming a rare infective agent but is still an offender on occasion. Its incidence is greater in cases of criminal abortion. In this disease, the prevention is fairly certain and the treatment less so. (11)

The list of possible infective agents might stretch out indefinitely as practically all known causes of infection have been reported as a cause of puerperal infection. Organisms considered saprophytic may become pathogenic in this region when the defenses break down. With large amounts of degenerating debris from an exfoliating endometrium and the presence of retained blood and serum, an invader from any source might find an ideal culture media. The idea that saprophytes are incapable of invasion breaks down in the advancing necrosis and these supposedly harmless organisms become capable of prostration and even death.

Knowing the agent causing the disease, thus has some value in determining the prognosis and, in a few cases, the treatment to be pursued. In the case of streptococcic infection, much work is being done with the use of vaccines, but due to the extreme specificity of the vaccines, the results in reports show great variance in their effects. Bacteriophage is a new experimental and interesting phase of bacteriology that seems to show



great promise. Bacteriology shows indication of becoming more valuable to medicine, besides an agent for determining the prognosis, and indicating the treatment in an occasional case. At least, the infective agent has been brought to light and can be studied so that conditions unfavorable to its existence and propagation may be worked out by the many able investigators in this field. (3)

Semmelweis distinguished two modes of infection which he called exogenous and endogenous. He showed that much of the exogenous type could be prevented. (3) By modern care of the pregnant woman, the incidence to both types of infection is lowered. Adequate prenatal care tends toward the removal of endogenous types of infection, while careful and conscientious care during and after delivery can prevent the establishment of the exogenous type.

Since the establishment of the cause of puerperal infection, there has been some difference of opinion as to the relative frequency of the two modes of infection. Some authors have entirely discounted the possibility of endogenous or auto-infection. From this standpoint, it is considered that the important point is that a woman's resistance is variable, but foci of infection are discounted as unproven, and local bacteria found in the vagina are considered as of but mild virulence. The teaching that infection is sometimes endogenous is considered dangerous since the source is usually in doubt, and, in this, there might be enough excuse for the practitioner to for-

get some details of an aseptic technique. (14) Undoubtedly, contact infection should always be guarded against and never forgotten, and obstetric specialists with careful technique usually have a minimum of mortality from this cause. On the other hand, when an infection is contracted, an attendant does not have to receive the blame necessarily, because the sources are so varied. The vagina is never sterile and no labor can be entirely aseptic. Innoculation might easily occur by the upward passage of vaginal bacteria or arise by the infection of the vagina in the movement of the vulval pad. The woman may contaminate herself by adjusting the pad or examining herself for a suspected tear. (11)

Vaginal examination is not practiced near the time of labor except under the most aseptic conditions, but the sterile finger may serve to carry bacteria from a site near the vulva to the site of a tear or abrasion nearer the cervix. Rectal examination is not without danger in that, in estimating the degree of dilatation, the vaginal folds are stretched out and placed in approximation with the gaping cervix. Some authors advised that a hand once introduced into the vagina returns contaminated and requires a change of gloves or washing in a strong antiseptic solution. (15) In the technique of intra-uterine manipulation, the hand is allowed but one entrance because the second entrance is accompanied with a much greater incidence to infection. (16)

Doderlein, in his work on the flora of the vagina, has distinguished two forms of vaginal secretion. In the normal, he found the bacillus that carries his name (B. Doderlein) growing in an acid medium with a secretion that was slight in amount and had an appearance like curdled milk. The secretion and flora changed in amount, color and viscosity when an infection was found. He put forward the idea that the B. Vaginalis (Doderlein) was normal and a protective agent against infection. He advised lactic acid douches as this tended to increase this favorable flora. (10)

The presence of cervical erosions or ulcerated cicatrices from former labors are a possible source of infection. In modern treatment, these foci are removed during pregnancy without danger of producing an abortion if the operation is done after the first irritability is over and before the 28th week. In studies of morbidity, the clearing up of these foci has been shown to reduce even the morbidity to a lower figure. (17)

The status of foci of infection at a distant source, such as a tooth socket, inflamed tonsils, appendix, gall bladder, et cetera, is not a proven fact. Certain studies show that foci exist in areas with but little sign of their presence demonstrable and that from these points, infection may be set up at distant sites. It is presumed that the bacterial agent at times is able to enter the blood stream and attack an area of lowered resistance. There are many who do not believe<sup>may</sup> this sort of

infection can play much part in puerperal infection but since the point is unproven and therefore possible, it seems the wisest to consider all possible sources of infection as dangerous. It has been proven through epidemics, that a comparatively innocuous nose or throat infection may become a very serious infection when the parturient woman receives it. (18) This is one of the exogenous sources of infection.

Existing in the patient's own body, however, the organism is supposed to produce a resistance of the body to its harmful nature. The local resistance is considered to be high, the body resistance in normalcy is considered to be good, but, in the pregnant woman, some factor may be absent and thus allow the lodgement of infection in a traumatized area. In proof of the focal infection theory, there is cited various examples. As a result of an acute cold, "refrigeration during the menses", a virgin may contract an acute pelvic peritonitis. As a result of a severe exposure, an osteomyelitis may develop. (3)

The modern obstetrician has but little to do with these considerations. The occurrences of infection in the genital tract after a cold or in company with an intercurrent infection in the body may be proven fact or mere conjecture but, since infection from foci may be possible, it is considered the best practice to treat uncovered infections. Along with this treatment, he seeks to help the pregnant woman build up and strengthen her body for the labor that is to ensue, hoping that she will be better able to resist an infection, should she be at-

tacked. (17)

Exogenous infection is an ever present menace to the woman in labor. The three factors necessary for infection are always found in the parturient woman. There is always some trauma; always bacteria; and always a media for the growth of bacteria. In addition to these necessities for infection, there are factors present which tend to lower the resistance to infection at delivery. These are trauma, loss of blood- especially in large amounts- toxemia, and intercurrent disease. Glandular disease, such as hypothyroidism, may also lower resistance. A deficiency in diet, especially in some essential as a certain vitamin, may be encountered or some one of the many unexplained causes. (19)

With all the sources of infection about the woman in labor, and with what has been given before, it will be necessary, in the description of exogenous infections, only to give the most common sources of infection. The physician or midwife is given the tittle of the most common source of puerperal infection. The nurse is more rarely found to be responsible. The physician cares for the sick and diseased and often he must go from an infective case to a maternity. He is exposed to infections and is apt to contaminate himself in caring for an infectious fever or in dressing an infected wound. In passage from one individual to another, bacteria often take on an increased virulence. A focus of infection may be on his own per-

son in the form of a felon, a furuncle, an eczema of the hands. In the 1840s, a famous illustration of a physician carrier is found in the person of Dr. Rutter, who seemed to be followed by puerperal infection wherever he went. A number of deaths occurred before the doctor found the source of the infection in an innocuous infection on a finger. (6) In hospital services, with the most careful care of lying-in patients, an epidemic will occasionally occur. These infections are usually traced to nose and throat sources of some of the attendants and these carriers isolated before the disease gets under control. In some instances, the dust is found to be infected with a possible air bourne infection. (18) Air as an infective agent is another moot question. Authors may be found on either side of the question as to whether the air is capable of carrying bacteria. DeLee states that he has recently changed his viewpoint in favor of the possibility that air, especially when dust laden, may be a source of danger. A sterile field, dressings, and instruments may be contaminated by coughing and sneezing certainly and, for this reason, masks are worn at deliveries the same as at surgical operations. That pathogenic bacteria may remain alive in air for varying periods, has recently been demonstrated. In clinical studies, DeLee states that, with practically the same technique in all deliveries, he has found his highest incidence to morbidity in the general hospital; the next highest in the general hospital with a separate maternity division; the third highest in the

maternity hospital where no infected cases are accepted, and the lowest morbidity in the home of the patient. Studies along this line have also been made by other obstetricians with similar results. (3)

Insects, especially flies as usual carriers of filth, deserve a strict elimination from hospitals. That they carry disease has long been proven in the studies of disease such as typhoid.

In the period before bacteria were discovered and found to be the cause of disease, bad smelling air was thought to be a cause of disease. Infected discharges usually have an odor about them that is not pleasant, but the smell itself seems now to have a clear bill of health as far as infection is concerned. Bad air and lack of ventilation may cause a sudden death but this disease is not bacterial in nature.

Doctors and nurses may sometimes become carriers of diseases through exposure to them and, perhaps without contracting the disease, be able to spread it. Resistant hospital epidemics due to nose and throat carriers sometimes require that everyone wear a mask before the infection becomes controlled. Masking everyone who comes into obstetric and surgical wards might someday be the rule in the attempt to keep dust and air non-infective. (18)

The woman, before coming to the hospital, is apt to

bathe herself so that she will be more presentable unless she is warned against such a procedure. The water itself is clean but the tub is not and, in scrubbing her skin, the dirt goes into the water and some of this may be deposited in the vulva or may even enter the vagina. This danger is less in the primipara than in the multipara. In the latter, the labia do not close as well and a gaping orifice allows water to run in and out as she moves in washing herself. The shower is less of a danger since the woman stands and the vaginal orifice is pointed downward. The doctor prefers that the woman have no bath until reaching the hospital, when a trained nurse who understands possible sources of infection can give the bath safely, with care against contamination of the vulva. On entering the hospital, the woman is placed in bed with fresh linen and a sterile vulval pad is used to further protect the vaginal orifice. The bed pan can be a source of danger if it is not properly cleaned between each use. After each urination or bowel movement, the vulval pad is changed to prevent contamination from this source. An external douche is considered a desirable method in keeping the vulva clean after urination and bowel movements. In some maternity wards, no toilet paper is used. Instead, sterilized gauze is used by the nurse, who by vision can carefully prevent contamination of the vulva. (20)

The husband may be a source of infection. Coitus just before labor and even a few hours after labor has been recorded.



There is no method at present for the sterilization of the penis or urethra to prevent its carrying infection into the vagina. Educated people are more aware of this danger but, in the lower classes, the obstetrician should warn against coitus during the last two months of pregnancy for both the prevention of infection and the possibility of causing a premature labor. Midwives used to recommend coitus for their patients as a stimulus to labor pains, but more scientific and safer means have been discovered to accomplish this purpose. After labor, coitus should be interdicted for at least the duration of the discharge but cases are fairly common in which a woman may not have a normal menstruation between her pregnancies, in which she again becomes pregnant even before the lochia has become normal. (3)

Much has been written on the resistance and non-resistance of the woman in labor. Various views are obtained. Since resistance is but little more than a relative condition placed against an equally unknown factor stated as resistance, it is natural that there should be much variance in opinion on both of these subjects.

Pregnancy, though a physiological condition, favors infection in the processes incident to labor. Demineralization of the body for the fetus is considered a factor in lowered resistance. Changes in the liver, kidneys and other organs may be other factors in lowering resistance. The shock incident to labor with abrasions, trauma, contusions, jagged tears, anxiety and fatigue are also factors in lowered resistance.

Conditions lowering the vitality such as concurrent acute or chronic disease, toxemia, profuse hemorrhage, et c. are weakening to the woman's natural resistance. The gonorrheal woman is said to require special care because she has an especially lowered resistance. Rapidly successive pregnancies sometimes produce an anemia which, with even a moderate loss of blood, places the patient in danger. A dry labor produces more damage than normal with less protection against the upward advancement of bacteria. (21) Potter claims that by reducing the second stage to a minimum of time, the parturient is kept in a better condition by means of his so frequent version. His results seem to prove his contention as he has a minimum mortality rate. (22) Retention of membranes, themselves not necessarily infected, serve as excellent culture media as has been described above. Lochial retention causes fever but the condition is seldom continued long enough to become dangerous. (23)

With all these causes, sources, and predisposing factors to infection, it seems remarkable that a woman can go through labor and remain alive. Were it not for balancing factors, nature must surely have found a different method for reproduction, or man would not be found on this earth. The vaginal secretions are acid and have a special flora. This inhibits certain of the pathogens. The cervix is plugged with a thick, glary mucus preventing upward extension until it is replaced by the bag of waters which acts as a cushion for the dilating, presenting part.

With the rupture of this bag, the vagina is flushed downward. The head, as it descends with a rotary action, scrubs the vagina and, with the birth, there is a following gush of fluid. Instrumentation or version counteracts this mechanism as well as produces greater trauma. The uterus contracts and the placenta becomes loosened. As the placenta leaves the uterus, it peels downward by inversion, leaving a sterile surface above. The surface next to the amniotic fluid, which may have become contaminated, is kept downward and this also serves to scrub the vagina downward.

A profuse lochia, with some bactericidal qualities, is produced for a few hours. This aids in sterilizing and flushing the vagina of pathogenic agents. The uterus contracts down upon itself, cutting to a minimum the blood flow into the part. Lymph and blood sinuses are closed and the fluids expressed as a part of the lochia. Into the basal cell layers, there is a round cell infiltration, forming a layer of defense. The innermost layers of the endometrium slough and leave a clean surface behind. Protective cell layers act as a defensive agent through their ability to engulf bacteria and dissolve debris so that it may be discharged. These cells come from several sources. The connective tissue of the uterine wall sends forward a white cell. The blood and lymph contribute white cells. Before labor, there is observed a physiological increase in the white cell count of the blood. The uterine wall likewise, before labor,

manufactures a greater number of local tissue phagocytes. Added to these protective cells, another cell described by Professor Hoffbauer, arises in the broad ligaments during pregnancy. This cell is produced in large numbers and migrates toward the danger zone. The reticulo-endothelial system in the period before labor is stimulated to the production of phagocytic cells as a general preparation against possible infection. (19)

With these processes in mind, it can be seen that local interference may be ill advised in the presence of infection. While treatment does not belong to this discussion, the damage of the curette might well be discussed. Any intrauterine manipulation may carry infection upward and counteract the processes that have attempted to clean the cervix and vagina while preventing the contamination of the uterus. The curette will serve to spread an infection that was localized. Its blade is carried down within the protective cell layers. It is blind and may easily penetrate the boggy wall of a subinvolved uterus. Even skillful operators admit their own production of perforations of the uterus by curettement and avoid the operation except in cases where there is an urgent indication for it. The infection is carried deeper and spread farther and drainage is but little improved. Intrauterine douches are likewise considered poor policy. In general, flushing an infected wound with an antiseptic solution is good practice and the Carrel-Dakin treatment is a type that is successful for surgical wound infections. But due to

the peculiar physiology of the genital tract, douching is more likely to carry the infection deeper than it is to express the discharges externally. (24) Obstetricians generally disapprove of uterine douches, though a few are found who use this treatment and report success. (25)

Blood transfusions act as stimulants to the reticulo-endothelial system as do certain drugs and other therapy. The reticulo-endothelial system is a new term brought forward by Ashoff to include certain organs and cells with a common function of producing phagocytic cells. It has been found that the system acts, as a whole, on stimulation and that certain diseases tend to deplete its reserve with a consequent loss of resistance. Besides this, little is known and the term is but scarcely more than mentioned by recent authors. However, it may become a term in common usage if its proponents are able to prove its merits as a unit of value to the profession. (26)

As has been said, puerperal infection is a protean disease. Any bacterium or combination of bacteria may be responsible if they are capable of infection. With their variance in virulence, the patient also shows a variance in resistance. The site of infection plays a part as well in the clinical picture. The diagnosis is made on general or local signs of infection and thus the symptoms vary. (27) The presence of infection is easily diagnosed if it be of sufficient importance to warrant anxiety. The extent of the disease is another matter, however,

and is very difficult and sometimes impossible to gage accurately. The seat of the original infection is within sight by speculum if it is in the vagina or cervix, but above this point, vision fails and palpation from the abdomen may give but little information. Knowing the infectious agent involved, is an aid in prognosis since study of the various types give a clue to the probable course of the disease but many times this knowledge is not obtainable until the disease has reached too advanced a stage to be halted in its course. Classification rests upon the diagnosis of the disease and depends upon the various factors. Therefore, it is not an exact quantity for so often many of the factors are unknown. A study of the pathology as a factor in the disease is of value in adding one more link to the chain leading toward an accurate diagnosis. (3)

Infection starts in an abrasion or wound somewhere in the path of the fetus through the birth canal. This includes the vulva, vagina, cervix, and the body of the uterus with a special emphasis on the site from which the placenta has become detached. (28)

The vulva is commonly traumatized in labor to a greater or lesser degree. At every labor, the accoucher attempts to save the perineum as the head passes it and, with the delivery completed, he examines it carefully suspecting a tear. In order to save a lacerated edge, he artificially widens this constricted passageway by a clean cut which he knows is more likely to heal

rapidly providing an infection can be prevented. (21) Even though carefully applied, forceps increase the incidence to tears at the outlet as well as to partially nullify the protective agencies by their introduction. (29) Manual manipulation in the same way is apt to produce abrasions. Acting as conveyors, hands and instruments may become contaminated and carry infection within the canal. Stitches help to close the wound by approximating the surfaces and sealing them off but should the wound become infected, they are of negative value and require removal to increase the drainage from the infection. (30) Instead of healing, an infection produces an ulcerated state, sometimes with a membrane forming over necrotic tissue and a discharge that turns foul. (11)

Puerperal vaginitis is caused again by trauma and infection. It becomes swollen and red or ulcerated and with a foul secretion. With these two sites, the prognosis is good as the infection can be well drained. The scarring that results, however, may produce bad effects in later pregnancies or the contraction of the scar tissue may result in an atresia. The speculum is here contraindicated as it further traumatizes devitalized tissues. Douches and internal manipulation are likewise dangerous with acute infection. (31)

The cervix with tears or abrasions is the next upward site of infection. On account of its continuity with the endometrium, its infection is more dangerous than infection below

this point. With localization, an infection becomes chronic with the production of an erosion. (11) Some difference in opinion exists as to whether it is best to repair a lacerated cervix immediately after delivery or whether it is better to wait until after a normal convalescence and the subsidence of an infection if it is about to arise. Possibly the late repair method has the most proponents at the present time since it is a dangerous point in the generative tract. (32)

Endometritis occurs by extension of infection upward into the uterus through the cervix. Normally, The uterus is sterile although the vagina never is and the cervix is frequently infected. Some break in the protective processes allows bacteria to gain access and lodge in the mucosa. The most dangerous site here is the placental site since infection finds a better medium in the traumatized area with deep sinuses into the wall where sloughing is less likely to dislodge it. From a deep focus, it may spread via lymph or blood or travel through the boggy walls to broad ligaments, or through the walls to the peritoneal surface. The placental site has been shown to be a weak point in the wall for some months after delivery. (28)

Two forms of endometritis are described. A putrid type has a roughened mucosa and a slough of necrotic tissue and debris. There is a foul discharge of a bloody or frothy type. The cervix is eroded as the secretion seeps over it. The uterus does not involute normally. A septic type may be limited to the



placental site or may form a cast of the entire cavity. (11)

Pieces of placental tissue may remain in the uterus for weeks without infection. They are dangerous as likely sites of lodgement of infection, however, especially if there has been any intrauterine manipulation. The placenta is examined as it is delivered with its membranes to be sure that it is intact. In miscarriages, the placenta, membranes and fetus should be examined as this may uncover information that perhaps would lead to a future, successful pregnancy. (33) To keep the placenta intact, enough time is allowed for it to separate and gentle force is directed around and behind it by Crede's method rather than pulling on the cord. With pieces of placenta left in the uterus, the organ does not contract well and tends to hemorrhage. Hemorrhage lowers resistance to infection as has been explained above while the presence of subinvolution tends to absorption of toxins through the improperly closed venous and lymphatic radicals. An infection in the endometrium is seemingly expected by nature, for during pregnancy, white cells are made with a general migration to the region of the uterus after labor to form the first line defenses as described above. (19)

A metritis signifies an infection that has burrowed within the wall of the uterus. This may be found by multiple abscesses or may be a continuous, unlocalized type of infection producing a gangrenous condition of the uterus. (11)

From an endometritis or a metritis, a parametritis may

become established, or parametritis may come directly from an infected cervical tear without going through the endometrium. A parametritis is a cellulitis of the connective tissue about the uterus. This type of pathology produces edema, then fibrinous adhesions which result in a "frozen pelvis". Masses may be felt at either side of the uterus in the broad ligaments if examination is not contraindicated by an acute infection of the vagina and cervix. If the organism is a pyogenic type, characterized by the production of large quantities of pus, abscesses form and tend to point in the cul-de-sac or, less commonly, over the inguinal ligament. Treatment of this condition is somewhat in dispute. (11), (49), (31). Some authors advise opening through the cul-de-sac and draining through the vagina while others say that it points itself in due time and interference is unwarranted. If the abscess does not come to a point, it will resolve after months but leave gynecological symptoms for some time to come. (11)

Peritonitis is produced by lymphatic extension or perforation of the infected uterine wall. Adnexal lesions may produce a peritonitis. The commonest cause of this type of infection is gonorrhea. An old latent infection is lighted with a lowered resistance and thus enabled to spread. The peritonitis in this type of infection is of the milder type and soon becomes chronic as resistance is again established but permanent adhesions are left to produce later trouble. (11)

A septicemia may occur beginning at the placental site and become established by lack of uterine tone through the open venous radicals. Infected thrombi are formed which may break off small emboli to lodge at various points causing metastatic bacteremia. Thrombus formation is a dreaded accident of any type of surgery. In obstetrics, thrombi are apt to form through the changes in the size of the uterus and the sudden shutting down of the blood supply on completion of labor..

When infection accompanies thrombus formation, a different picture is obtained. The sudden death caused by the large embolus lodging in the lung is rare, although it may be seen. Instead, there is a septic temperature and the venous return from one or both legs is interfered with. The cause is a thrombus beginning in the pelvic veins. This extends to the femoral or saphenous veins. The left leg, for anatomical reasons, is most often affected and the result is called phlegmasia alba dolens, or commonly, milk leg. (11) Milk leg is a survival of an old term explanatory for the formerly ascribed reason for the condition. The leg is swollen, white and painful, and due to the usual suppression of the milk that accompanies it, it was thought to be caused by the milk going inwardly to the leg. (3) Actually, of course, it is an interference in the venous return, caused by plugging of the large veins in the legs. Several types of phlegmasia alba dolens are found which depend upon the veins affected, whether an infected thrombus or a simple thrombus is

present, and whether in the infected type, the disease is localized or a cellulitis is allowed to form. If embolism can be prevented and the infection is not too virulent, a recovery is the rule. With modern asepsis in obstetrics, the disease is becoming more rare except the milder types of cases. (11)

Diagnosis of puerperal infection is not the simple matter it may seem at first thought. Fever is generally present but it may be absent or from another source than the generative tract. It is common to find a fever when the milk first comes into engorged breasts. Diagnosis may often require the slow and careful exclusion method rather than the brilliant snap diagnosis. Since the group of diseases represented by the term puerperal fever is so varied, the symptoms and signs are also varied. Almost any disease may be simulated along with the ever present possibility of having two simultaneous diseases, one of which being puerperal infection. Knowledge of the prenatal and labor history are usually helpful, together with complete examination and the available laboratory data. Fever, increased pulse, and pain in the infected area are usually to be found. Some change in the lochia, reduced lactation, retarded involution are frequent findings. (34)

In lesions of the vulva and vagina, the temperature is usually of the low grade fever type that does not tell much to the observer. The pulse may also be but little affected. There are, however, local signs that are diagnostic. There is discomfort on defecation or urination, pointing to this area and exam-

ination shows the lesions. Here the temperature and other signs must be watched and the patient carefully treated to avoid a higher, complicating infection. (11)

An endometritis usually begins with a chill and a following temperature that goes to around 104 degrees and a pulse of 140. The elevation is constant or septic and complaints are malaise, headache, abdominal tenderness. Metritis cannot be differentiated from an endometritis. (11)

A parametritis may escape notice in a mild case with but a slight rise in temperature or pulse. Examination reveals tenderness in the abdomen but this may not be remarkable. With the formation of an abscess, local symptoms call for examination. With drainage, recovery is usually prompt. Without good drainage, the lesion may absorb or, by exacerbations, the disease recur until there is complete absorption.

Adnexal lesions tend toward chronicity with resulting abscess or absorption and pyosalpinx with later surgery required. Peritonitis shows itself by the third day unless it is dependent upon rupture of an abscess or through some other cause, it is not set up immediately after delivery. There is a definite chill with high temperature and pulse. The pulse becomes weak and collapsible; pain is constant. Tympanities succeeds a board-like abdomen. An early diarrhoea is followed by constipation. Vomiting occurs and may become projectile. The patient is sleepless, restless, the facies are of the Hippocratic type and the tongue furred. Delirium and coma appear and death occurs after

a drop in temperature and an increase in the rate of the weakened pulse. (13)

In pyemia, symptoms are rare before the seventh day. This condition exhibits chills as the bacteria enter the blood in showers and in between, there are remissions. If death does not occur, the condition will become chronic. (11)

Phlegmasia alba dolens seldom occurs before the tenth day post partum. There is pain along the vessel affected, with tenderness to the touch. Edema below the lesion is found and the skin of the edematous leg has a peculiar, glistening, white appearance. The clinical course is mild as a rule with the fever slightly elevated. Chronicity is the rule with some residual trouble in the leg for years afterward. (11)

Septicemia may be rapidly fatal. It follows some local lesion and appears with an initial chill and then a temperature of 103 to 106 degrees. The pulse curve often goes higher than the temperature suggests. The pulse rapidly becomes weak and thready. Delirium and mania are usual accompaniments. The blood shows anemia, urine shows casts and albumin, and offensive diarrheas exhaust the patient. A milder type terminates by lysis.

In an ideal condition, there should be no mortality or even a morbidity from labor for either mother or child. Labor is a normal, physiological process invented by nature to enable men and higher animals to exist. While many of man's habits have

changed in past generations since he first decided to walk upright, there seems to have been little if any improvement possible in the matter of bearing children. Carrying the developing fetus within her body and then bringing it into the world, is still a great drain on the mother's resources of health, though in many other ways, the risks of life have been lessened. It is true that much has been done to aid the mother in this process. The work of Semmelweis, in showing how disease can be prevented, and the work of a host of other investigators, have helped to reduce the risks the mother must take. Bacteria have been studied and catalogued, along with the conditions that favor their growth and also the ways to prevent their growth. They can be seen and their presence diagnosed before the conditions they produce are found clinically. The diseases have been studied and the lesions are better understood. The bacteria, along with less understood causes of infection, are still with us and still an ever present source of danger. (35)

In the United States, a number of women die every year from diseases incident to childbirth. The number estimated is somewhere near 16,000 in a year. This figure is obtained from the Bureau of the Census which, since 1903, has been compiling statistics relating to births and deaths and their classification. Not all of the states subscribe to the registration of births and deaths by census, but the ones that do, send reports that are estimated to include about 95.7 % of the total population of the Continental United States. (36) Six or seven of every

one thousand women who are confined die. (39) In comparison with other modern countries, The United States was found to be sixteenth in the list of maternal mortality statistics, which means that, if this report is true, we have very little to be proud of along this line of advancing civilization. This report is much questioned (37) and has given rise to considerable literature in both lay and medical presses. (38) Another statement made by DeLee is that " in Europe as well as in America, of every 200 women who become pregnant, at least one dies before the reproductive function is completed. (3) The gynecologists state that about one third of their work is due to poor results in labor. (40)

Of maternal deaths, the single greatest cause is puerperal infection. About 40% of these deaths are due to this cause statistically. (36) This is the same disease that Semmelweis showed to be preventable. The next largest cause of 27% is due to puerperal albuminuria and convulsions, also classed as preventable. 10% are due to operative attempts to save life, and the remaining 23% are the result of accidents of labor of which many should also be preventable.

For the year of 1927, Nebraska carried out an investigation of maternal deaths, in which the doctors caring for the women who died were consulted in confidence in order to evaluate the census returns, and, at the same time, to check up on prenatal care given. Of 165 deaths, 70, or 43% were found to be



puerperal infection and of these deaths, 13.3% could actually have not been prevented, being due to abortions. Other interesting points brought out were that 74 had live babies and 9 were undelivered. Prenatal care was generally considered inadequate and the city was credited with three times as many abortions as the rural type of population.

Nebraska is the first state for which such a tabulation has been made. The report states that the mortality rate is less than that of the country as a whole.

Tabulations are usually made on the basis of deaths per 1000 live births. The registration area's rate being 6.6. In this way, the maternal deaths are checked in comparison with fetal deaths. (42)

In the given causes of death, it will be seen that the preventable part is the largest part of the deaths. It is estimated that the mortality of childbirth could be reduced to about one per thousand if the public were properly instructed regarding the needful precautions and if the physicians were capable of meeting obstetric emergencies, and most important, if they practiced a strict aseptic technique. A certain unavoidable mortality comes from disease of the adnexa, uterus, and pelvis, and from general affections aggravated by parturition, but it is small compared with the preventable mortality. (3)

Prophylaxis, then, is the great hope in this disease. It is preventable, though apparently the attempt to prevent it

is not gaining headway as it should. The recent publicity attending the publishing of the comparative death rates is regretted by some (38) and by others is considered a great boon toward prevention of death. (36) If the public would call for the necessary treatments to prevent disease, it would add, rather than subtract from the physician's income. (43) Thorough prenatal care and treatment during the pregnancy is possible and with but little risk. It is much better for the patient to have early treatment than to wait until after the disease is contracted. (17) The training of the physician in obstetrics is gradually becoming expanded but requires still more extension if it is to meet the proportion of medicine in which it is found in general practice. (44) The physician himself is apt to become careless after he has been away from medical centers for some time. A certain aseptic conscience is considered essential by some authors, a conscience that will not allow him to do otherwise than his best in every case. (15) Obstetric emergencies may often be prevented by careful following of the case and less heroic but better results through early treatment obtained before the emergency develops. Should an emergency develop, however, he should be able to meet it from his experience and training rather than to lose valuable time. (44)

A part of the mortality not considered preventable could also be prevented if certain views regarding contraception were adopted. Proponents of this science seem to be increasing and

as practical as the method seems, it would be adopted if age-old customs, religion, et c. would allow it. Birth control is practiced almost universally in the better mentally equipped portion of the population. For those who should have this knowledge, however, it is obtainable through official sources in most cases. If the necessary information were imparted to all mothers who are considered physically inadequate to have children, a number of deaths would be prevented.

Miscarriages and abortions occur when the mother is not able to continue caring for the growing fetus or embryo. The cause of the condition, when disease is the main factor, also lowers the resistance to infection and thus, this type of delivery has a mortality rate over that of normal labor. The therapeutic abortion is considered a fairly safe procedure, although it is not without risk. Its indication in this country is only to save the mother's life but this is not always obtainable.(45) In some of the European countries, notably in the Soviet States, abortion is legalized for other reasons, such as the prevention of unwanted children. There the deaths from abortion are rather a rarity, probably because the mother is in better condition and because the operation is ~~not~~ performed against the law by poorly trained abortioners in a furtive manner. (37)

The criminal abortion is the alternative in this country for many cases where the lack of contraceptive knowledge has resulted in an unwanted pregnancy. The infection resulting from this interference is so common that every criminal or self in-

duced abortion is considered septic until proved otherwise. Abortion statistics are, of course, not obtainable. However, abortions are acknowledged to be increasing as women find that unwanted pregnancies can be interrupted. Early prenatal care and acquaintance with the danger of this operation should help to limit its occurrence. (46)

The obstetric specialist and the maternity clinic operating under an obstetric specialist has a comparatively low mortality. In the lack of adequate figures for comparisons, the morbidity is estimated. This is measured by a number of standards, and the standard used shows considerable variance in the results. The usual morbidity is placed at around 10 to 20% when the indication of morbidity is a temperature of 100.5 degrees for two consecutive days, excluding the first day post partum. This does not include morbidity that develops later nor does it include morbidity when there is no temperature. It serves as a valuable method for estimating results of asepsis and properly conducted labor. (4)

In hospitals where both paid and charity cases are taken, studies of mortality have shown that, of the two classes, forceps and other operative deliveries have occurred to a greater extent among the private patients. This class has also suffered the highest morbidity. This is considered to be caused by the fact that the pay patient is more impatient at the slowness of nature and the obstetrician more eager to show his skill.

The patient pays later for this consideration by increased discomfort and risk in the puerperium. (29)

The instillation of mercurochrome in the vagina during labor has been studied in controlled cases for the prevention of morbidity and it has been found that morbidity is slightly decreased by this procedure. Other mild antiseptics have also been used with similar slightly lessened morbidity. (23)

Preparation of the vulva by shaving and antiseptic painting is now a standard practice in hospitals and the practice is slowly gaining headway in home deliveries as men of more recent training in obstetrics enter the field. (44)

Other studies have shown differences between the use of rectal and vaginal examinations made during labor. The rectal examination seems to be considered the safer and no examination is even better where the progress is normal. (47)

By the use of these studies, it is possible to improve methods without the sacrifice of life to establish better principles. Williams makes a statement which seems very pertinent to this discussion of prophylaxis. He finds that the mortality rate is lowest in the large cities because there are good hospitals to care for the patients. That the next lowest rate is found in rural districts where often the doctor cannot get to patient in time for the actual delivery. Then the highest rate is found in smaller cities where facilities are not quite ade-

quate and where every doctor considers himself an obstetrician. His statements are confirmed by public health studies. (2), (48)

Along with the work of preparing this thesis, illustrative case records were sought. Examples of many types of infection were found among the patients who had been treated at the University Dispensary and Hospital, so that the only difficulty lay in classifying them so that a few cases would be representative of the many. Two cases were chosen as representative of the morbid condition, but, with a mild type of infection or a rugged resistance, recovered from their disease. Two septic abortions are included, one being a typical case and the other showing an infection which is considered to be quite rare. Two cases were chosen from puerperal infections with death resulting as representing maternal mortality.

In the cases reviewed, a search was made for women dying from childbirth after a normal labor with only rectal examinations made, and without some very suggestive, predisposing cause. This type of case is to be found in the literature but there seems to be none on record at this hospital.

Case I. Mrs. B.N. White, age 27. Hosp.No. 36,527.

This patient entered the hospital on Oct.8, 1931 on account of the onset of labor. She reported her last menstruation began on Dec. 28,1930. She had been married 7 years and had 3 children living and one miscarriage of a two months fetus. Her history was negative for family diseases, personal or organic diseases. Menstrual history was also negative. Her reasons for entering the hospital for this baby were severe past labors and poor home conditions.

Her pregnancy this time had been uneventful, with only moderate vomiting in the early months and no adverse signs in the last months. She was a well nourished woman of stated age. Breasts were normal; uterus halfway between umbilicus and ensiform with the fetal back on the left and fetal heart heard in the lower left quadrant. No vaginal examination was made but a rectal examination showed the head level with the spines and the cervix partially effaced and dilated.

Later examinations proved the presentation to be a left occiput posterior. Delivery was effected by a manual rotation to an anterior position and the head drawn down by forceps to birth of the head by extension. The loss of blood was moderate and, after delivery, no tears were found. The placenta was delivered 15 minutes later with some difficulty and judged complete. With the placenta delivered, she was given hypos of ergot and pituitrin. In later hours, she was given another dose

of ergot, morphin and strychnin.

Urine samples were examined and found to be normal except traces of albumin. The blood Wasserman was negative. After the delivery, the red cells of the blood were counted at 3,200,000 with a hemaglobin of 60%. The white cells were counted and reported as 9,300 with a normal type of distribution.

On the second day postpartum, the patient exhibited a pulse rate that increased to 140 with a normal temperature. The temperature on the following day rose to 103 degrees with a continued elevation of the pulse. She complained of pain in the lower left quadrant. On the fourth day her temperature was up to a high of 103 degrees, but from this point it declined in the following days until a normal was reached by the sixth day.

The increased pulse and temperature called for more laboratory data. A blood culture made on the third day remained sterile for three days. Blood counts were made on the fourth day post partum with a result of 20,000 white cells and 70% neutrophils. On the next day, the count of whites was 14,600 with 62% neutrophils.

During the febrile period, the treatment given was of the expectant and palliative type. Absolute rest and pushing of fluids was ordered. Ice bags to the lower abdomen and enemas were ordered to relieve local congestion. Phenacetin and aspirin were given for the fever and discomfort. Potassium citrate was used to combat an acidosis. Ergotin and quinine were given every



four hours as uterine stimulants.

With the regression of fever, the patient began to convalesce with remarkable rapidity. By the ninth day post partum, she was feeling so well that she insisted, against the advice of the house physician, on being dismissed from the hospital.

This is an example of a puerperal fever of the mild type. The fever appeared on the third day but it was preceded by 24 hours by a significant rise in pulse rate. The source of the infection or toxic condition was probably the delivery with the need for manual rotation and forceps. The delivery was in the hospital, in the delivery room, and under the best conditions possible.

Case II. Mrs. L.O. Age 16, white Hosp. No. 32,910  
The patient entered the hospital on a stretcher Sept. 5, 1930 with the following complaints; chills followed by fever, pain in the lower abdomen and headache.

Of positive points revealed by history, she shows no childhood or family diseases of moment. She had been married but three months as her parents did not give consent to her marriage, until her pregnancy became apparent; because of her age. In her recent pregnancy, she had had swelling of the ankles, but no spots before the eyes and no symptoms referring to a changed blood pressure. Some nausea and vomiting were present in the early months of pregnancy.

Menstruation began at ten years and recurred regularly at 30 day intervals, flowing moderately about 5 to 7 days. After the pregnancy was established, there was no recurrence of menstruation. No genito-urinary symptoms were reported.

She was delivered at home by the county physician on Aug. 28, 1930. One week later, she developed a chill and a fever following, with headache, profuse sweating, delirium and restlessness. Another doctor was called, who fearing for her safety in the home with inadequate care, sent her to this hospital.

The delivery was accomplished from a breech position in about seven hours. No note of the baby's weight was given. The vulva was not shaved, although other precautions were taken. She was considered a normal convalescent until one week after delivery when these complaints developed.

On entrance by stretcher, she lay pale and quiet with a blue tinge to the lips and a slight flush on the cheek bones. The tonsils were large and cryptic with palpable anterior cervical lymph nodes. The heart beat was 140 and without murmurs. Temperature was 103.6 degrees and respiration was 28. A soft doughy mass was found in the lower abdomen and interpreted as a subinvoluting uterus. Although palpation of the abdomen was painful, the recti muscles were not considered as overly rigid. A diagnosis of puerperal infection was made by the admitting officer.

In the laboratory, urine examinations were made showing

some cloudiness and a trace of albumin but otherwise normal. The red cell count was slightly over normal and white count was 11,800 with 64% neutrophils. The blood Wasserman was negative.

During the first four days in the hospital, her temperature was up to 103 degrees several times with the pulse rate elevating to 140 with the highest temperatures. Treatment instituted was: Fowler position, ice to the lower abdomen, forced fluids, quinine and ergot every 4 hours, aceto-salicylic acid and pyramidon for pain, vaginal and breast preparation and external pours.

Under hospital management, the patient did well. After the first four days, the temperature receded to normal and she was discharged after 16 days in the hospital and the last 5 days without temperature. This is an example of a puerperal infection of a mild type, showing morbidity but progressing satisfactorily under treatment.

The cause, pathology, and organism were unknown. The patient is a healthy, youthful woman with her first baby and with good resistance. The organism was not virulent, at least for her. The source of the infection is also unknown, but several points are to be noticed in this connection. The delivery was in a home of few conveniences. The position was an unfavorable one as a breech but labor was completed in 7 hours. The vulva was not prepared, although the delivery was not precipitate and other

precautions can only be guessed as probably also minimal. After the delivery, the post partum care was inadequate. In many of these cases in poor families, the woman is given the minimum of care and is presumed to be alright unless the doctor is called again. No check of the fever may be made until the disease may be well advanced.

The tonsils were not above reproach and may have been the source of this mild infection. In the homes of the lower classes, coitus may sometimes be indulged in at an early date after delivery and an infection produced in that way. That this woman was pregnant some time <sup>before</sup> marriage and that they were both young, might point to this cause as a possible one. (3)

Case III. Mrs. H.C. White, age 25. Hospital No. 12,905 This patient entered the hospital on Feb. 5, 1924 with the following complaints: severe cutting pain and continuous pain in the abdomen for one week, purulent lochia.

Childhood diseases were the usual ones with adult diseases of influenza and myocelitis. Eye, ear, nose and throat were normal. In gastro-intestinal history, she complained of belching and discomfort after meals which was relieved by soda or food. She was inclined to constipation. There were no genito-urinary symptoms until the present illness. She has had attacks of rheumatism since childhood.

Menstruation began at 14 years, regular, and lasting

six days. At the time of her marriage three years ago, she noted a profuse discharge which cleared up in a short time. After marriage, she flowed regularly as before. On last Nov. 24, she flowed profusely and claimed normal periods since that time.

Her father is living and has stomach similar to her own. Her mother is living but has a dropsical condition. Three sisters are normal except one who has irregular periods. Three brothers are well and one died of chorea. Her husband and two children are well. No miscarriages were reported.

On examination, a young woman of good nutrition, pale and in pain, was seen lying in bed. Positive points of the examination were not found until the abdomen was reached. The abdomen was tender both above and below, distention and a shifting dullness were noted. The thighs were kept flexed and she preferred to lie on the right side in bed. Vaginal examination revealed a mass in the right fornix. Extremities were negative.

She was referred to this hospital by her doctor who left the diagnosis in doubt but favored appendicitis among possibilities of several conditions such as salpingitis, tubal pregnancy, ruptured ectopic pregnancy and peritonitis.

Laboratory tests showed a normal urine and blood count except for a slightly elevated white count at 8,600 of which 87% were polys. Blood Wasserman was negative. A smear from the cervix showed Gram negative diplococci. A blood culture remained

sterile for three days.

The temperature ranged from 99 to 103 degrees and pulse was from 100 to 160. Respirations varied between 20 and 70. Her temperature was always above normal and usually around 101 degrees. Another white count was made and showed 9,000. Another blood culture became positive for *Streptococcus Hemolyticus*.

Her condition became progressively more serious and by the fourth day, she was delirious and so was transferred to a room where she would not be a menace to herself or other patients. One week after entrance into the hospital, she weakened and, showing the cross of increasing, weakening pulse and a fall of temperature, died in the early evening as a heart death.

Treatment began with a soft diet, fluids, and precautions against the spread of the Neisserian infection. Ice bags to the abdomen seemed to relieve some of the discomfort. Fowler's position was employed and colonic flushing daily was used to help elimination. Morphin was ordered for pain as often as every three hours if necessary. Caffeine-sodio-benzoate was ordered as a stimulant. When delirium developed, a hypodermoclysis was ordered to increase the fluid intake and, after meals, 20 minims of dilute hydrochloric acid were given. Sodium citrate was given beginning on the seventh day in one half dram doses and quinine was also given beginning at the date.

The diagnosis was incomplete at the time of death and

permission for an autopsy was granted. In a rational moment before death, the patient admitted that she had produced an abortion three days before the onset of the entrance symptoms. She had used a small stick and, passing it into the vagina, was successful, after several attempts, to reach the cervix. A small two months fetus was passed and the membranes followed. She became fearful about her condition but was not ready to confess until she was sure that she was in grave danger. The act was self-induced and without given reason.

Autopsy revealed dehydration of the skin and a peritonitis was found on entering the abdomen. About two quarts of milky fluid were found in the abdomen. The odor of the fluid was putrid. The liver was not enlarged but the spleen was several times its normal size. The stomach showed no abnormalities to account for former symptoms. Exudate was found on the under surface of the diaphragm but there was no perforation.

The uterus was about twice the normal size and a recent placental site was in evidence. No clots or retained membranes were present in the uterus and the vessels of the broad ligaments were patent.

The pleural cavities contained milky fluid and the lungs were free and without adhesions. Congestion was present in both bases. The pericardial cavity and heart were normal.

The causes of death by autopsy were: pregnancy and

septic, self-induced abortion, peritonitis, pneumonia of both lower lobes and Streptococcus Hemolyticus septicemia.

The case here presented represents an example of a criminal abortion of the septic type. An exception to the rule, was that the patient was very reticent as to the cause of her condition, while usually, if the operation is done by someone else, the patient feels free to tell all the details. She was married and had two normal children but, dreading another pregnancy for some reason, she had listened to a story about an easy way to produce a miscarriage. The mass in the fornix found on entrance was probably the site of an abscess occurring through perforation and infection of an insufficiently localized and inadequately draining wound. She was apparently of good resistance and the infection was of increased virulence. It failed to remain localized and spread to the peritoneum. The blood counts did not show a greatly increased leukocytosis as a virulent streptococcus infection cannot be judged as a rule, by this means. Transfusions were of but temporary aid.

Case IV. Mrs. L.N. White, age 35. Hospital No. 20,481  
The patient entered the hospital with the following complaints: pain in back and thighs, nausea and gagging sensations, profuse menstruation.

Only a fragmentary history could be obtained as the patient was very ill. She stated that she had gone past her period a few days and then began to have severe cramps. This was



followed by the profuse flow which was continuing. A year ago, she had a normal delivery in this hospital (No.14,588). She disclaimed a recent miscarriage as the cause of her condition.

On examination, there was seen a woman of about the stated age, lying in bed, in pain, and with some suggestion of icterus in the sclera and skin. The heart sounds were distant but distinct and without murmurs. The pulse was rapid and collapsible. Lungs were clear of rales. An old scar in the appendiceal region was noted.

The only signs of pathology found in the examination were in the abdomen. This was tender in all quadrants but especially in the lower quadrants. No rigidity was found in the recti muscles, however, and no masses were felt in the abdomen. She seemed very sick but signs of pathology were minimal. She was unable to void and required catheterization. She had an apparent difficulty in respiration with a respiratory grunt in evidence. Temperature was elevated to 103.8 degrees with a pulse of 124 and a respiratory rate of 26 on entrance examination.

She was not in the hospital long enough for much laboratory work to be accomplished. A cervical smear, however, showed no gonococci, but did show many organisms of both Gram negative and Gram positive staining. A vaginal examination did not suggest pathology.

The first impression was dysmenorrhea but this was in question because of the prostration of the patient.

Treatment instituted was soft diet, enemas and general measures. Fluids were increased because of the temperature. A continuous proctoclysis was begun in which was added soda and glucose for an attempt to combat acidosis and provide additional nourishment. Digifolin and caffeine-sodio-benzoate were used as stimulants. Enemas were ordered before the proctoclysis was started.

On the next morning, the patient had a severe chill that was followed by profuse perspiration. The face became flushed over the cheek bones, the pupils were dilated and cyanosis of the lips was observed. The temperature at this time was 103.4 degrees with a pulse of 113 and a respiration of 24. There was an increasing difficulty in breathing. A similar chill and fever followed in the afternoon. On the next morning, another chill followed and a more jaundiced skin and sclera were noted. Her wrist became pulseless and as a doctor was called, she died.

Since the diagnosis was in doubt, an autopsy was requested and granted by the relatives. In this examination, a general gas formation was found in all organs with considerable congestion and degeneration of internal organs. A recent placental implant was discovered in the uterus. The autopsy diagnosis was: septic abortion, probably self-induced, bacteremia

of B. Welchii, and no evidence of trauma in vagina or other pelvic organs.

This case is an example of a rarer type of puerperal infection. It is a type of complication of criminal abortion or other unwise or accidental deep wound infection. No history of an abortion or miscarriage was admitted but the autopsy gave definite findings of a recent placental implantation. The woman was in fair health and was the mother of several healthy children. The findings pointed toward an instrumental abortion although no evidence of trauma was discovered. The disease was rapidly fatal with an onset of only four days before death. On entrance to the hospital on the third day of the disease, the infection had advanced too far to stay its progress.

A number of bacilli cause the production of gas but of these, B. Welchii is the greatest gas producer. The infection develops within 2 to 36 hours after the injury. It usually remains local but with a symbiosis, may become general. The symptoms during the first 24 hours of the disease are: Pain, disproportionate to the amount of the injury, mental stimulation, protracted shock and a greenish-gray membrane over the wound, with a characteristic odor.

Treatment is early debridement and free opening of the wound. Tetanus perfringens antitoxin serum is used. Local treatment is hydrogen peroxide or potassium permanganate as wet dressings. Transfusion and early amputation if necessary.

In the case of puerperal infection, this treatment obviously cannot be applied as it can to an extremity. Douches are contraindicated; amputation is of questionable value. Diagnosis almost requires a good history if treatment is to be early enough to be successful. The bacteria must have dead tissue for continued growth. When it fails to remain localized, it spreads through the body, producing necrosis with an early fatal termination.

Case V. Mrs. C.M. White, age 18 Hospital No. 10,600  
The patient entered the hospital on April 1, 1923 on a stretcher with the following complaints: pain in vulvar region of left side, constant soreness on left side, and yellowish discharge from the vagina. She was delivered a week ago, Mar. 25, 1923, at a maternity home. She was in labor 21 hours and low forceps were required to bring the head down. She was apparently convalescing normally until on the fifth day, she began to develop the above complaints. She was then brought to this hospital for further post partum care.

Her family history was negative and her husband and baby were living and well. She herself has had the usual diseases of childhood, and in adult life, influenza and small pox. There have been no injuries nor operations. By the usual questioning, it was found that the only other complaint to be added was pain on starting to urinate. She began to menstruate at 16 years, flowing regularly and for 4 or 5 days. Her last menstrual period began on June 7, 1922.

On inspection, the examiner saw a fairly well nourished girl, lying quietly in bed, not complaining of pain. Heart and lungs were normal and also eye, ear, nose and throat. The abdomen was tender especially over the lower quadrants with the most tenderness over Morrison's point on the left side. Temperature was 102 degrees and pulse was 100 with respiration at 22.

Laboratory test showed a trace of albumin in the urine and many pus cells and epithelial cells. There were also a few casts. On the 12th day in this hospital, the urine was similar except for a one plus albumin and many pus cells with still but a few casts. A blood count was made on her second day which showed a normal red count and the white cells were 24,100 with 83% polys and 17% lymphos. Blood Wasserman was negative. Temperature ranged from 102 to 106 degrees and the pulse from 120 to 160 with respiration from 20 to 48.

On the third day, her temperature mounted to 105.8 degrees and the discharge from the vagina was noted as greenish-yellow. She became irrational that night with restlessness and occasionally, she would scream. The next day, she was given 100 cc. of a streptococcus polyvalent serum, diluted with saline solution intravenously. A septic chill followed which she soon threw off by means of hot water bottles. Her temperature then mounted again to high levels. The next day, she could keep none of her food down and was very restless but had regained

rationality. On the fifth day, she seemed better and gained control over her nausea. During the night, she again became irrational and restless.

On the seventh day, she took a turn for the worse. 65cc. of the streptococcus serum was given, again followed by a chill requiring external heat. From this time on, her progress became regressive and by the 12th day, her respiration rate was 48. On the 13th day, the temperature reached 107 by rectum with a pulse of 160 and respirations at 36 and from this point, began to fail rapidly until she died in the early evening.

Upon entrance, she was put on a soft diet and with the usual post partum orders of external douches and breast care. Early alkalizing by soda, drams one, three times a day was also begun. Then as a combatant to dehydration, fluids were pushed with a proctoclysis of normal saline by rectum. An ampule of caffeine-sodio-benzoate was given on the third day.

With the irrationality developing, the proctoclysis was increased and 2% soda and 5% glucose given with the fluid by rectum. Morphine was ordered in one-sixth grain doses for the pain and restlessness as needed. Restraint of arms and legs was needed to keep her in bed. The intravenous serum given was noted above as specific treatment.

An autopsy was done and revealed that the abdomen was

not distended and no masses could be felt. The cavity contained about 200 cc. of fluid. Diaphragm showed no adhesions to the liver and the liver was normal in size but rather pale. Its substance cut with a uniform, increased resistance. The gall-bladder was normal in appearance. The spleen was enlarged about one half over normal size and was covered with numerous, small, hard, yellow nodules of pin head size. These nodules were scattered also through the cut surface of the spleen. The pancreas was pale; the stomach was in normal position and its walls appeared normal. The small intestine had a glistening, smooth wall and the mesenteric glands were not enlarged. The appendix appeared to be normal. The large intestine was contracted and empty. Kidneys were soft, red, and not resistant and with well-defined striations.

In the pelvis, the bladder was empty and contracted. The uterus rose one third of the distance to the umbilicus. It was sharply antiflexed, hard, pale, and with no areas of discoloration. IT was free from adhesions with other viscera. The endometrium was soft, red, and sloughing with a membrane in its upper pole that was yellow and easily separable from the endometrium. The tubes appeared normal as were the ovaries and the pelvic vessels were patent throughout.

The thorax revealed glistening pleura with free fluid in the bases of the cavities. The upper right lobe was adhered to the parietal pleura and contained cheesy nodules, larger

than those found in the spleen. The lower lobes on both sides showed a red-brown color without areas of consolidation. The pericardium contained some free fluid and the heart was normal.

Diagnosis based on the findings at autopsy was: Suppurative metritis, pulmonary and splenic tuberculosis and the primary cause of death was puerperal sepsis with a streptococcic septicemia.

This woman developed a fever on her fifth day post partum. A positive culture of streptococcus hemolyticus was obtained during the course of her disease. There was present an existing tuberculosis of lungs and spleen before delivery that apparently was first discovered at autopsy but which very probably decreased her resistance to infection and, should it have been a milder type, she would likely have soon been overcome by the tuberculosis through its well known attack of weakened structures. The treatment given her was ineffectual as her course was steadily worse from her entrance. Polyvalent serum seemed to do about as much harm as good, at least it did not halt the progress of the disease in the dosage given and she did not seem to take the serum well.

Infection evidently entered during labor with a hard delivery requiring forceps, or in post partum care. It was first noticed on the fifth day. It did not spread locally to pelvic organs but gained the circulation and struck the lungs which already were carrying a tuberculosis infection. There was no



history of tuberculosis in her family or contact with the disease or of past symptoms pointing to infection except in the influenza that she had had ten years before.

This is an example of a puerperal infection implanted in an individual carrying a chronic disease. Both conditions of low resistance and a virulent agent were present.

Case VI. Mrs. D.B. White, age 19. Hospital No. 31,610

This patient was treated in the prenatal clinic of the dispensary and, from this record, it was found that her last menstrual period was Oct. 25, 1929. Usual childhood diseases were reported and adult diseases consisted of pneumonia 12 years ago.

She was found to be subject to colds, although the tonsils and adenoids had been removed when she was a baby. She was somewhat short of breath on climbing stairs. Menstruation began at 12 years, regular except for three months about three years ago when she was 16 years old. Family history showed no chronic diseases. She was married Dec. 16, 1929.

On examination, venereal warts were found on the labia and a cervical smear was reported positive for Gram negative diplococci. The venereal warts had been present for sometime and she thought that they were becoming smaller and dropping off. She was sent to the physical therapy department for treatment by X-ray if indicated but it was considered better to wait until the pregnancy was terminated before this treatment was

advisable. She was therefore treated with silvagar packs in gynecological dispensary until she was too near term to make this advisable.

She entered the hospital as labor pains came on at term on April 20, 1930. She reported no visual changes nor dizziness but had some edema of the ankles. Measurements of the pelvis were normal and the presentation was LOA. She was given sodium bromide, grains XXX and chloral hydrate, grains XV by rectum because of much suffering in first stage which lasted 26 hours. The second stage lasted one hour and 45 minutes and the delivery was accomplished without the use of internal manipulation or instruments. The baby did not breathe regularly ~~and~~ artificial respiration was necessary. However, it died two hours later. The delivery was considered "not difficult". The placenta was delivered by Crede method in an intact condition and not abnormal. The total delivery time was 28 hours.

A second degree laceration was found and repaired immediately after delivery. Pituitrin and ergot were given as the placenta delivered and the woman left the delivery room in fair condition.

Urine examinations gave no indication of pathology. Blood counts showed white cells elevated to 16,700 and a decrease to 4,800 before the termination of the disease. A vaginal smear was positive for Gram negative intracellular diplococci. Blood Wasserman was negative. Blood sedimentation time

was given as 21 mm. in 15 minutes. ~~A~~ blood culture was negative. The treatment was general with the special treatment indicated in the progress notes.

On the second day post partum, a septic type of temperature and pulse curve developed and chills were observed. The highest temperature was 103 degrees and with this phenomena, there was no especial pain except an increased pelvic soreness. A moderate leukorrheal discharge was noted.

On the next day, the patient seemed worse and had a continued hyperpyrexia. Rectal irrigations of hot magnesium sulphate were given, with elevation of the head of the bed and morphin for restlessness and ice to the lower abdomen. A 500 cc. transfusion was given.

On the fifth day, the patient felt better but had excessive tenderness in the pelvis. There was a slight discharge from the vagina. The temperature was up to 103 degrees rectally and pulse at 130.

On the sixth day, toxic delirium was noted with a continued septic temperature and some increase in abdominal pain. The vulva was again prepared and an internal examination was made which revealed a bilateral cervical tear and pus escaping from the cervix. There was no bulging in the fornices or cul-de-sac. A milk injection of 10 cc. was given as a stimulant.

On April 29, 1930, the patient became definitely worse

with a weakened pulse and a rattle of moisture in the throat. The right chest had coarse rales. Intravenous glucose 4% and 1000 cc. was given but she died a cardiac death a few hours later.

An autopsy was done and free fluid was found in the abdominal cavity, the peritoneum was injected generally, including the omentum and a thick, purulent exudate was found in several sites. The lungs showed congestion in the lower lobes. A recent septic infarct was found in the spleen. The uterus had a large, infected cervical tear. The endometrium was soft with edema. A thrombus was found in a vein in a broad ligament.

Diagnosis made by autopsy was: puerperal sepsis, prenatal infection of cervix uteri, and general peritonitis.

This patient is an example of inadequate prenatal treatment and subsequent infection. She had a chronic Neisserian infection which was of such long standing that it was considered to be impossible to clear it up before her baby was due so that palliative treatment was given instead. Gonorrhea is said to reduce the patient's resistance to other infection.

Other factors were normal with a fairly easy delivery and without instrumentation and under aseptic conditions. A second degree laceration occurred and was repaired immediately. She showed signs of sepsis beginning the second day post partum but blood cultures remained sterile. She died on the ninth day

post partum with an autopsy diagnosis of general peritonitis originating from a prenatal infection.

Summary.

- 1- The etiology of puerperal infection has been understood since the middle of the 19th century, with only minor additions since that time.
- 2- It is a wound infection primarily, with the streptococcus the usual agent in the virulent infections.
- 3- Although considered a preventable disease, it is still the major cause of death from childbirth.
- 4- It is rare in the practice of a well trained practitioner or specialist except in cases where interference with the normal processes occurred before he had taken the case.
- 5- It can be prevented by adequate prenatal care, aseptic delivery and good post natal care- routinely and conscientiously.
- 6- Elimination of the disease requires education of the public to demand better and more complete obstetric care and the education of the physician to meet the demand.

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